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Department of
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Soil
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Washington, D.C.

in consultation
with

USDA Salinity Control
Coordinating Committee

1984 Annual Report Colorado River Salinity Control Program

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FOREWORD

The Colorado River Basin Salinity Control Act of June 24, 1974, (Public law 93-320) provides for the enhancement and protection of the quality of water available in the Colorado River for use in the United States and Mexico. This 1984 Annual Report on the Colorado River Salinity Control Program (CRSCP) has been prepared to explain the progress, the activities, and the salinity control accomplishments achieved by the U.S. Department of Agriculture (USDA) program. USDA has continued to maintain reasonable progress with implementation of onfarm irrigation improvement and salinity control under authority of existing programs. In the future, when the federal budget deficits have been substantially reduced, funding for the new USDA authorities recently enacted (PL 98-569, October 30, 1984) can make substantial contributions in reducing overall salinity levels in the Colorado River for the benefit of the many downstream water users.

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I. INTRODUCTION

A. General

This years USDA annual report is presented as an abbreviated version. For explanation and background information on the scope and nature of the Colorado River salinity problem, please refer to the 1982 and 1983 Annual Reports on the Colorado River Basin Salinity Control Program. These earlier reports are available through the USDA, Soil Conservation Service, Land Treatment Program Division, P.O. Box 2890, Washington, D.C., 20013.

In 1984, the USDA Colorado River Salinity Control Program (CRSC) continued very much like the programs in 1982 and 1983. Planning and implementation activities were continued under authorities of existing USDA programs. The results and accomplishments were very similar to 1982 and 1983.

The major accomplishments for the USDA program in 1984 was in the legislative area with the passage of PL-98-569 (formerly HR. 2790), amendments to the Colorado River Basin Salinity Control Act of 1974. This activity and accomplishment is discussed further in the Legislative Activities section of this report.

II. INSTITUTIONAL AND INTERAGENCY COORDINATION

The institutional and interagency coordination structure remains essentially unchanged from that presented in the 1982 and 1983 reports (See Figure II-1). In 1984 more internal USDA interagency coordination was undertaken. With passage of new salinity control legislation, the USDA Salinity Control Coordinating Committee has become more active.

Because of organizational changes and shifts in program responsibilities in the Soil Conservation Service (SCS), Mr. Robert R. Shaw, Director of the Land Treatment Program Division, has been designated the USDA Salinity Control Liaison Officer replacing Mr. Edgar Nelson, Director, Basin and Area Planning Division. The USDA Salinity Control Liaison Officer also serves as Chairman of the USDA Salinity Control Coordinating Committee.

The Colorado River Basin Salinity Control (CRBSC) Advisory Council and the CRBSC Forum continues to provide input and leadership in the overall program on behalf of the seven basin states. In the past year, the Agricultural Stabilization and Conservation Service (ASCS) has become more actively involved in meetings with the Advisory Council and Forum because of program management responsibilities resulting from PL-98-569.

SCS has also taken the initiative to strengthen technical coordination with the US Bureau of Reclamation (BR). There now exists a BR/SCS Technical Policy Coordination Committee which meets periodically to discuss and resolve any technical policy coordination issues. In the past, there have been technical differences in salt loadings and salt load reduction numbers, economic analysis and procedures, cost-effectiveness determination procedures, and the planning and implementation schedules. As these technical issues are being addressed, progress and status reports are being provided to the USDA Salinity Control Coordinating Committee and to the CRBSC Forum Work Group representatives. These technical coordination sessions have helped immensely in identifying and resolving technical or procedural differences between the USDI and USDA agencies. Figure II-1 illustrates where the BR/SCS Technical Policy Coordinating Committee fits into the interagency coordination structure and it's relationship to the Forum Work Group and the USDA Salinity Control Coordinating Committee.

INSTITUTIONAL AND ORGANIZATIONAL STRUCTURE

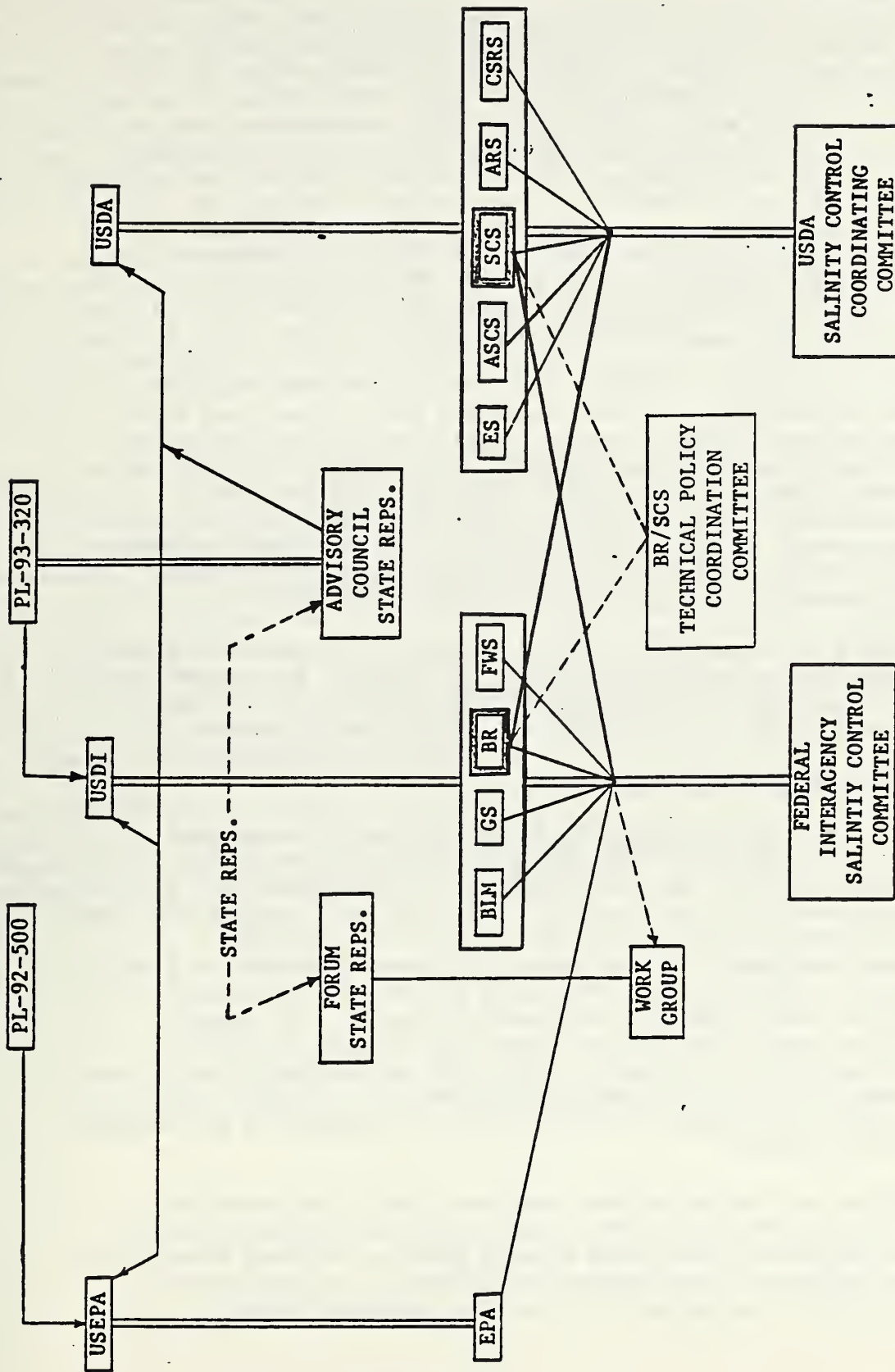


Figure II-1

III. LEGISLATIVE ACTIVITIES

Four different bills on Colorado River salinity control before the Second session of the 98th US Congress made 1984 a very busy legislative year for USDA. These bills were S.1842, S.752, HR 2790 and HR 3903. (See the 1983 USDA Annual report for further explanations.) Two bills, S.1842 and HR 3903 related specifically to authorization of a separate and voluntary USDA onfarm Colorado River Salinity Control (CRSC) program. The other bills, HR 2790 and S.752, amended the existing Colorado River Basin Salinity Control Act of 1974, PL-93-320. These later two bills also included provisions for a voluntary USDA onfarm program. HR 2790 was eventually passed by the US Congress and signed into law on October 30, 1984 as PL-98-569. [A copy of PL-98-569, amendments to the Colorado River Basin Salinity Control Act of 1974, is included as Appendix 1.]

In addition to numerous briefings with various Congressional staffs and staff representatives of both House and Senate Committees related to Agriculture and Interior programs, USDA also provided supporting testimony at various committee hearings. On April 3, 1984, Richard D. Siegel, Deputy Assistant Secretary for Natural Resources and Environment, testified on HR.2790 in behalf of USDA before the House Subcommittee on Water and Power Resources of the Committee on Interior and Insular Affairs. With several amendments suggested by USDA, Mr. Siegel testified in support of the enactment of HR 2790.

HR 2790 would essentially provide the necessary legislative authority USDA and the Reagan Administration needed to support the FY 1984 and 1985 budget requests for a coordinated USDA Colorado River Salinity Control Program (CRSC). The numerous technical and editorial amendments presented by Mr. Siegel were eventually adopted and incorporated into PL-98-569.

On April 3, 1985, Deputy Assistant Secretary Siegel testified on S.1842 and H.R. 3903 before the Senate Subcommittee on Soil and Water Conservation, Forestry, and Environment of the Committee on Agriculture, Nutrition and Forestry. H.R. 3903 had already passed the House of Representatives and had been referred to the Senate agriculture committee. Both of these bills were introduced on behalf of the Reagan Administration and USDA to provide the legislative authority for the FY 1984 and 1985 budget requests. Mr. Siegel's testimony was again favorable and supportive, however one minor editorial amendment was proposed. H.R. 3903 was eventually acted upon by the Senate agriculture committee and moved to the Senate floor for action. HR 3903 eventually died when H.R. 2790 passed and was enacted into law as PL-98-569.

H.R. 2790 was not enacted without some last minute controversial issues. Senator Metzenbaum (Ohio) had sought and eventually secured increased non-federal cost-share support from the Colorado River basin states and individual USDA program participants. The Environmental Policy Institute, Washington, D.C., and the National Wildlife

Federation (NWF) also sought some last minute changes. Nearly all of the issues raised by these two groups were related to environmental and procedural aspects effecting the USDI salinity program, not USDA While ASCS and SCS provided technical support and program explanation, it was representatives of the Basin States, the CRBSC Advisory Council, and the CRBSC Forum, who negotiated and resolved legislative difference with NWF, Environmental Policy Institute and Senator Metzenbaum's office. H.R. 2790, with appropriate and agreed upon amendments, then passed the U.S. Senate and the House of Representatives. H.R. 2790 was signed into law by President Reagan on October 30, 1984.

The USDA Legislative Summary of PL-98-569 provides a basic overview of the special provisions of the USDA onfarm CRSC program. It should be noted that this overcomes two major obstacles for implementing voluntary onfarm salinity control presently being experienced using existing program authorities: 1) lifts the annual cost-share payment limitation of \$3,500, and 2) provides for technical assistance and cost-sharing with irrigation districts or canal companies.

A specially significant feature of PL-98-569 is the increased non-federal reimbursements from the power revenue funds (Upper Colorado River Basin Fund and Lower Colorado River Basin Development Funds) to the US treasury for 30 percent (%) reimbursement of the USDA federal cost-sharing with program participants. With 70% USDA federal cost sharing, this makes the actual federal cost-share (or expenditure) 49% and the non-federal cost-share 51%. In this case, 30% comes from program participants and 21% (30% of 70% federal cost-share expenditures) comes from power revenue basin fund reimbursements. This increased non-federal cost-share provision of PL-98-569 is a prime example of the current water project financing and cost-sharing policies advocated by the Reagan Administration. It reflects a new and increased non-federal project partnership arrangement with the basin states.

Other USDA activities related to legislation includes the formulation of proposed rules and regulations and the establishment of a Secretarial Delegation of Authorities which identifies USDA agencies functional roles and responsibilities for implementing the program.

USDA LEGISLATIVE SUMMARY
of Public Law 98-569

Amends the Colorado River Basin Salinity Control Act to authorize the Secretary of Agriculture to develop and implement a coordinated agricultural onfarm program in the Colorado River Basin. The Secretary of Agriculture is directed to:

- o Give preference to new projects that achieve the most salinity reduction at the least cost per unit.
- o Identify salt sources and determine salt loading.
- o Develop implementation plans with public inputs to reduce salt loads to the Colorado River. Plans may include onfarm water management and related lateral improvements, erosion practices which significantly affect salt reduction, and replacement of wildlife values foregone.
- o Provide technical and cost-share assistance through a voluntary program using contracts and agreements. Assistance may be provided to individuals, groups of owners and operators, and is expanded to allow assistance (especially cost-sharing) with irrigation districts and canal companies. Cost-shares to be based on benefits received and provision for continued operation and maintenance shall be included in contracts and agreements.
- o Provide continued technical assistance for irrigation water management, plus monitoring and evaluating changes in salt contributions to determine program effectiveness.
- o Include research, demonstration and education activities in the voluntary onfarm salinity control program.
- o Limit Federal cost-share level to 70 percent, unless the Secretary determines that such a requirement would result in a failure to start needed onfarm measures. A minimum of 30 percent cost-sharing will be required from program participants.
- o Use existing agencies and the Commodity Credit Corporation to carry out the program. Agencies may use grants or cooperative agreements with conservation districts, local governmental agencies, colleges and universities, or other as appropriate to carry out authorized activities.

- o Submit reports to Congress January 1, 1988, and at 5 year intervals thereafter. Reports may contain evaluation of the program, legislative recommendations, and recommendations on new technology and research needs.
- o Provides for 30% reimbursement from power revenues generated in the Upper Colorado River Basin Fund and the Lower Colorado River Basin Development Fund to the Federal treasury for USDA federal cost-share expenditures with program participants.

IV. FUNDING AND BUDGETING

For FY 1985, USDA developed and submitted a consolidated account for the USDA CRSC program identical to the FY 1984 budget requests. The FY 1984 budget request was not funded due to lack of legislative authority, however, S.1842, S.752, H.R. 2790, and H.R. 3903 were all pending before the 98th Congress. USDA fully anticipated that one of these bills, any of which could have provided the necessary legislative program authority, would pass in time for a FY 1985 appropriation. The legislation was not passed in time to honor the FY 1985 requests of \$12.5 million. Therefore, ASCS and SCS budgets were funded at the lower base level under a continuing resolution of the U.S. Congress.

The consolidated account for the CRSC program was developed under the leadership of ASCS and SCS with full support and concurrence of the Under Secretary for International Affairs and Commodity Programs and the Assistant Secretary for Natural Resources and Environment. Funds included in the consolidated account would be budgeted and appropriated through ASCS and would cover ASCS, SCS, and Extension Service (ES). These funds would support federal cost-share assistance, technical assistance, salinity planning studies, monitoring and extension education support. Funds for research activities in Agricultural Research Service (ARS) and Cooperative State Research Service (CSRS) were not included in the consolidated account.

The FY 1985 funding levels were merely an extension and continuation of prior year funding levels. As a result, the two ongoing salinity control projects (Grand Valley, CO and Uinta Basin, UT) were funded at the lower levels through the Agricultural Conservation Program of ASCS and the SCS conservation technical assistance program. SCS salinity planning activities and Extension Service education programs were not funded for FY 1985.

The general breakdown and fund distribution for 1983 through 1985 are as follows:

Agencies Activities	FY 83 <u>Actual</u>	FY 84 <u>Actual</u>	FY 85 <u>Approp.</u> ^{1/}	FY 85 <u>Request</u>
	-----(\$ millions)-----			
ASCS				
Cost Sharing	4.0	4.0	4.0	10.0
SCS				
Technical Assistance	0.6	0.6	0.6	1.5
Monitoring	0.4	0.2	0.2	0.7
Planning Studies	0	0	0	0.15
ES				
Education	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.2</u>
	5.0	4.8	4.8	12.55

^{1/} Continuing Resolution in lieu of annual appropriations.

The budget requests were based primarily on the "modified" USDA CRSC implementation schedule developed for the FY 1983 and 1984 budget requests. This modified implementation schedule presented in the 1983 Annual Report reflects the earlier concepts of a more gradual and realistic transition into a full scale implementation program. With continuing federal budget restraints and with passage of new enabling legislation, the current USDA implementation schedule will likely be revised in FY 1985.

V. USDA TITLE I ACTIVITIES (Wellton-Mohawk, AZ)

Highly saline drainage return flow from the Wellton-Mohawk Irrigation and Drainage District (WMIDD) in Yuma County, Arizona, created the downstream salinity problems for Mexico in the 1960's which resulted in Minute No. 242, and the passage of Public Law 93-320, the Colorado River Basin Salinity Control Act of 1974.

USDA activities under Title I of the act are primarily related to improving irrigation efficiencies, reducing deep percolation, and reducing highly saline irrigation and drainage return flows from the 65,000 acre WMIDD. As farmers over-irrigate, excess and unused irrigation waters percolate down through the soil profile creating a high water table enriched with high salinity levels. To overcome the agricultural production problems caused by salinity build-up and poor drainage, pump-drainage wells were used to lower the saline high water tables. This "pumped" drainage water, with salinity concentrations ranging from 3,000 to 6,000 parts per million (PPM), was then removed from the Wellton-Mohawk area through drainage canals and ditches discharging into the Colorado River. These highly saline return flows caused increased salinity concentrations in the Colorado River waters delivered to Mexico.

A separate provision in Title I was the construction of a concrete lined by-pass drain to divert saline drainage water to the Santa Clara slough until the desalinization plant would be constructed near Yuma, Arizona.

In conjunction with the BR planning for the desalting plant authorized in Title I of the Act, an Advisory Committee on Irrigation Efficiency and a support Technical Field Committee on Irrigation Efficiency were created. These interagency committees were formed to develop alternatives to improve irrigation efficiencies and to reduce drainage return flows. This would ultimately reduce the size and costs of building and operating a large desalting plant. A 1974 "Special Report: Measures for Reducing Return Flows from the Wellton-Mohawk Irrigation and Drainage District" includes the specific recommendations for installing onfarm measures and technical assistance.

The "Initial Program," consisting of 23,800 acres of irrigation and salinity control improvements, is complete. A "Program Extension," consisting of 19,000 acres of regular onfarm treatment and 18,950 acres of irrigation water management, should be completed in 1986.

In 1984, 59 plans were developed and contracts signed on 8,105 acres. Practices applied included 28.2 miles of ditch lining, 4,623 acres of laser leveling, and 678 structures for water control and measurement, see Table V-1.

The Soil Conservation Service is designing and assisting farmers to install irrigation systems to reduce irrigation return flow. As of September 1984, 318 contracts have been developed for assistance on 44,275 acres. Surface irrigation systems are currently being planned for 31 cooperators on 2,990 acres and 63 applicants are awaiting assistance on 5,951 acres, and treatment should reach 53,216 acres of the total 65,000 acres in the project. Since implementation of the Colorado River salinity program began in 1975, the irrigation return flows have been reduced about half or approximately 100,000 acre-feet.

Level basin systems are being installed and irrigated through jack gates with an irrigation head of 15 to 20 cfs to each basin. For proper irrigation management the water turned out to each basin is accurately measured and the time set to within 5 minutes to replenish the soil moisture. The Irrigation Management Services (IMS) program provided through the Wellton-Mohawk Irrigation and Drainage District provides information on soil moisture on 40,000 acres using neutron probe measurements.

The cumulative accomplishments by the SCS onfarm program to achieve a reduction in return flow, on the Wellton-Mohawk Districts are presented in Table V-1.

Table V-1.

USDA Onfarm Accomplishments
Wellton-Mohawk Irrigation and Drainage District

Accomplishment Item	1975 to Sept. 1984 Cumulative	FY 1984
Acres under application	53,200	53,200
Number of Plans	318	59
Area Planned (acres)	44,275	8,105
Ditch Lining (Miles)	214	27
Laser Leveling (acres)	37,081	4,623
Water Control Structures (No.)	9,248	678

Major Wellton-Mohawk program impact.

Inflow diversions from Imperial Dam have been reduced about 20% or 100,000 acre feet and drainage pumping to maintain stable ground water levels has been reduced in half or about 100,000 acre feet. Gila River flood flows in 1978-80 and 1983, high precipitation, the 1983 Payment In-Kind (PIK) program (about 9,000 acres of cotton not grown in 1983), and cropping patterns are some factors which have affected the water budget evaluation of program impacts during the last six years. The combined impact of the USDA onfarm irrigation improvement program, the BR Irrigation Management Scheduling program, and the BR land retirement and exchange program, and other efforts have been very successful in improving irrigation water use. The program should succeed in reducing drainage return flows to the goal of 108,000 acre-feet per year by 1987. Tables V-2 and V-3 indicate progress made to date.

Table V-2.

Reduction in Deep Percolation, 1984 IWM Contracts
Wellton-Mohawk Irrigation and Drainage District

Crop	Acreage under IWM (Acres)	<u>1/</u> Farm Delivery		1984 Efficiency Percent	Reduction in Deep Percolation Ac.Ft/Ac.
		Before Ac.Ft/Ac.	After Ac.Ft/Ac.		
Alfalfa	5176	9.84	7.56	82	2.28
Cotton	2760	5.56	3.93	89	1.63
Wheat	4511	3.49	2.78	79	0.71
Lettuce (Spring)	1338*	-----undetermined-----			
Citrus	37*	-----undetermined-----			
Watermelon	304*	-----undetermined-----			
Bermuda	638	5.24	4.13	80	1.11
Sesame	1381	3.18	2.30	87	0.88
Grain Sorghum	580	3.49	2.40	90	1.09
Sudan Grass	304	<u>3.49</u>	<u>2.59</u>	<u>85</u>	<u>0.90</u>
Total	17,038				1.45
	15,359 acres when farm delivery was recorded ^{2/}				

1/ WMIDD water delivery records.

2/ Deep percolation from 15,359 acres under irrigation water management contract in 1984 was reduced 22,340 acre feet.

Table V-3.

Abbreviated Water Budget ^{1/}
Wellton-Mohawk Irrigation and Drainage District

	1970-75	1976-80	1981-83
Flows	1,000 acre feet		
Inflow			
Flow from Imperial Dam	507	389	397
Crop Consumptive Use	261	247	238
Phreataphyte Consumptive Use	60	71	73
Outflow			
Drainage Pumping with no change groundwater storage	208 ^{2/}	174 ^{2/}	115 ^{2/}

^{1/} USBR data.

^{2/} Minus years with Gila River Flood Flow: 1973, 1979-80, 1983.

VI. USDA TITLE II ACTIVITIES

Title II of the PL-93-320 deals with the salinity contribution of the Colorado River above Imperial Dam and the program necessary to meet U.S. water quality standards while the Basin States continue to develop their compact-apportioned waters.

Specifically, Title II authorized the construction, operation, and maintenance of four U.S. Bureau of Reclamation salinity-control projects, including the USDA onfarm aspects of the Grand Valley Unit, Colorado. USDA planning reports have been completed for the Grand Valley in Colorado and Uinta Basin in Utah. USDA began implementation and installation of onfarm salinity control measures in the Grand Valley in 1979 and the Uinta Basin in 1980.

A. PLANNING. During the last ten years, SCS has taken the lead to develop USDA salinity control plans and published reports. Detailed salinity control surveys and investigations have been completed on nine units. USDA reports, with recommended implementation plans, were completed on six units: Grand Valley (1977) and Grand Valley Lateral Supplement (1980), Uinta Basin (1979), Moapa Valley (1981), Lower Gunnison (1981), Virgin Valley (1982), and McElmo Creek (1983). The Big Sandy report (1980) displays 14 alternatives, but no USDA recommended plan. Recent studies were made in Big Sandy, Wyoming which show feasibility for using low pressure sprinkler irrigation systems to reduce deep percolation and associated salt. This alternative appears to be more cost-effective and is being pursued further. The Mancos Valley USDA report has undergone interagency review and is being finalized.

Planning activities in '84 included completion of a Cultural Resources Assessment Report for Moapa Valley and the Virgin Valley in Nevada. A Finding Of No Significant Impact (FONSI) report is being prepared for the recommended salinity plans in the Moapa Valley and Virgin Valley. Public awareness of salinity legislation and possible funding has been discussed at local meetings of conservation districts, the Conservation Commission, Food and Agriculture Council, and Resource Action Council.

The Price-San Rafael USDA report is being modified by the Utah staff to incorporate important lateral improvements needed to support onfarm system improvements. USBR did not find lateral lining to be cost effective for salinity control as a separate increment, and investigation is now proceeding to determine whether a joint action alternative involving both agencies will be the most cost-effective solution. One element to be included in such an alternative is a community plan to improve winter watering practices for livestock. USDA has participated in public meetings to discuss the onfarm salinity program and has kept the local sponsors informed on opportunities for funding and technical assistance.

A cooperative River Basin study has been completed by USDA on the Colorado River Indian Reservation (CRIR). Several alternative plans have been formulated that conserve water on existing irrigated lands and allow full resource development on the Reservation. Data available from this study supports the hypothesis that there is a minimal amount of salt pick up on the CRIR. Another conclusion that could be drawn from the study is that long-term benefits of better irrigation systems and practices appear to have a relatively small effect on downstream salinity. The final USDA report on this study will be published in FY-85.

B. IMPLEMENTATION

Prior to passage of PL-98-569, Public Law 93-320 directed the Secretary of Agriculture to construct onfarm irrigation systems under programs available to that department. USDA implementation programs are being carried out in Grand Valley, Colorado and Uinta Basin, Utah under current USDA programs.

GRAND VALLEY

Irrigation system Improvements. The method of irrigation used almost exclusively in the valley is furrow irrigation. Irrigation slopes usually exceed one percent and soils have low water intake rates. Fields average about 10 acres in size. Existing earthen irrigation ditches are being replaced with concrete lined ditches, gated pipe, or underground pipelines. Some concrete ditches are constructed with a ported outlet for each furrow and accommodate timed control gates for semi-automated irrigation. However, gated pipe is becoming a popular and less expensive alternative to ported concrete ditches.

Some gated pipe is being fitted with cablegation controls as another type of semi-automation. Cablegation is the name given to the system where water pressure pushes a movable plug through gated pipe laid across the head of a field. The plug's rate of movement is restrained by a cable or other cord, hence the name cablegation. Water flowing through the gated pipe is discharged into the furrows through a limited number of gates in the pipe depending on flow rate and slope of the pipe. The flow through each gate varies from a maximum rate immediately behind the plug to no flow at some distance back from the plug. At any given gate the initial high flow rate enables water to reach the end of the furrow in the shortest possible time. The gradual decrease in flow permits water to percolate into the ground while minimizing runoff from the end of the furrow. Users of this irrigation method report 30 to 50 percent savings in time and water use while adequately irrigating the field. Because of these and other benefits cablegation is being accepted by farmers as a method of irrigation.

Program Accomplishments and Effects

Onfarm and off-farm lateral improvements in Grand Valley have been accomplished primarily through the annual practice cost-share provision of the ACP program in ASCS. Onfarm pipeline and ditch lining for 1984 was 116,433 feet and 26,249 feet respectively. Total onfarm pipeline and ditch lining accomplishments thus far are approximately 112 miles of pipelines and 36 miles of ditch lining. Combined, these accomplishments represent about 22.4% of the total Grand Valley projects goals.

Off-farm lateral improvements for 1984 consisted of 15,792 feet of pipeline improvements. Total off-farm lateral accomplishments for the project are 32.8 miles of pipelines and 10.8 miles of ditch lining, representing 22.9% of the overall project goals.

Onfarm seepage or deep percolation reductions are estimated to be 3,378 acre feet per year for an average salt load reduction of 17,027 tons per year. Off-farm lateral seepage reductions are 2047 acre feet per year for 10,295 tons of salt load reductions per year. Total seepage/deep percolation reductions are 5,425 acre feet per year for a 27,322 tons per year salt load reduction.

UINTA BASIN

Irrigation System Improvements

Prior to implementation of the selected plan a total of 35,100 acres had received treatment through improved irrigation systems. An estimated 10,200 acres were improved with sprinkler systems while 24,900 acres had received improved surface systems. Portions of these improvements were installed with assistance through the regular ACP cost share program.

Crop yields have also been reduced in areas with poor drainage and salt-toxicity problems. Decreasing yields of alfalfa and small grains are also evident in areas that have been continually over irrigated. This has resulted in a shift to more water and salt-tolerant plants.

Program Accomplishments and Effects

A total of \$7,623,017 in ACP-Salinity funding has been obligated from 1980 to 1984 on 20,573 acres through Long Term Agreements. In addition to this, \$1,339,722 was obligated for annual practices. These improvements included both sprinkler and surface systems. During the past three irrigation seasons, irrigation water management has been applied to a total of 10,929 acres of farmland. Salt reduction of 12,900 tons (6,550 acre feet of reduced percolation) has resulted from application of these structural and management practices.

C. Extension Education

Without the benefit of federal Extension Service funding support, the extension education assistance at the salinity control project level must rely solely upon state funding. In Colorado and Utah, the Cooperative Extension Service agencies have provided a base level of extension support including demonstration, information, and education activities.

Extension specialists conducted water management workshops and other educational programs for farmers, technicians, county agents, and personnel of agricultural services and supply businesses. They also worked directly with farmers in fine tuning irrigation practices to improve irrigation efficiencies and economy of operations. All of these extension education activities are valuable contributions to the improved awareness and understanding of the Colorado River salinity problems, the causes, the relationships to irrigation water management practices and the subsequent contributions toward salt load reductions.

In Grand Valley, a special irrigation extension agent has been working since 1983 to help with organizing local lateral groups for Bureau of Reclamation (BR) lateral improvements and USDA onfarm irrigation water management improvements. The position was established through a Memorandum of Understanding with BR, ES, and the Colorado Cooperative Extension Service with funding support provided by the Bureau of Reclamation. For 1984, this irrigation extension agent spent approximately 50 percent of his time working with over 600 different people on irrigation water management and about 35 percent of the time on lateral organization contacting nearly 400 individuals. The remainder of the time was devoted to other related extension activities and a special Extension newsletter with a distribution of nearly 1400.

D. Research and Demonstration

USDA research and demonstration activities are vital to the development of new and improved water management practices for control of soil and water salinity. Scientists at four ARS locations are involved in this coordinated effort: Riverside, California; Fort Collins, Colorado; Phoenix, Arizona; and Kimberly, Idaho.

U.S. Salinity Laboratory.

Two soil physicists have been added to the staff of the U.S. Salinity Laboratory; one will be located at Riverside and will initiate experiments to collect data and test models of crop response to salinity and irrigation management; the second will be located in Brawley, California and will conduct research to increase the intake rate of the heavy textured Imperial Valley soils in order to reduce runoff and improve irrigation and leaching efficiencies. The drainwater reuse project in the Imperial Valley, which was initiated in 1982 and described in the 1982 Annual Report, has shown no

reduction in the yields of cotton, sugar beets, and wheat when drainwater of 3000 mg/L salt has been substituted for 50 to 75 percent of the irrigation water. The lysimeter study described in the 1983 Annual Report is underway at Riverside to simulate conditions at the Imperial Valley test site. Another lysimeter study has been initiated in the San Joaquin Valley for testing a computer model for making general predictions of long term effects of using brackish waters for irrigation on soil and water properties. This study is in the data collection and computer programming stages. Computer mapping programs and strategies have been developed for both mini and microcomputer graphic systems to analyze and illustrate complex interrelated geographic information system data bases so as to delineate areas of potentially excessive salinity development in irrigation projects. Overlay maps were prepared for a 350 square mile section of the Wellton-Mohawk Irrigation District using data taken from 1968 to 1973. The predicted salination potentials for the area agreed well with salinity traverse data collected in 1973. Development of an expert system ("artificial intelligence") for salinity management is being considered subject to obtaining the necessary computer equipment at the U.S. Salinity Laboratory. The system will identify the type and cause of the salinity problem under consideration, identify appropriate actions or management practices to improve the situation and project and evaluate consequences and long term effects of alternative management practices.

Preliminary results of the ongoing stable isotope study in the Grand Valley indicate that the relative quantities of local groundwater which originate from Colorado River water, local precipitation and lateral flow from nonirrigated areas can be determined. About 1/3 of the wells sampled were concluded to contain water of non-Colorado River origin. Estimates of the relative contribution of these two sources of water to Colorado River return flow will be made. Separation of deep percolation and canal seepage losses using stable isotopes is still under study and requires further research.

U.S. Water Conservation Laboratory

Engineers at Phoenix, Arizona initiated cooperative studies with the Imperial and Wellton-Mohawk Irrigation and Drainage Districts in the Lower Colorado River Basin to intensively monitor canal responses to district operations. The monitoring programs will provide a data base for studying open channel water delivery responses and the interactions between various hydraulic and management inputs. Several canals in each district will be included in the study. Measuring structure construction and instrument installation will begin in 1985.

The flow monitoring equipment employed as part of the irrigation water delivery research project must be accurate, easily installed and maintained, and inexpensive (less than \$1,000 per measuring site). Engineers at Phoenix surveyed a large portion of the commercially available flow monitoring equipment and found it far too costly. They were not simple to install,

required a stilling well in many instances, required excessive power to operate by battery for extended periods and did not meet head-detection accuracy requirements. The most economical approach presently available to adequately monitor a number of water levels in the same proximity appears to be a recently introduced data logging system (Easy Logger by OMNIDATA) coupled with a bubbler/pressure transducer system developed at the U.S. Water Conservation Laboratory. Bartex, Inc., presently manufactures a water level sensing system, based on an acoustical (shock wave) transducer that is simple to use in the field, exceeds accuracy requirements but in its present form is too costly. The company is interested in developing a unit that includes a single sensor/logger with simplified electronics mounted directly on the side of a concrete lined canal, without a stilling well. The expected marketing price of such a unit is \$750 or less if the development, manufacturing and tooling costs were defrayed by the Government or other interested entities.

Agricultural Engineering Research Center

The principal research thrust of the Fort Collins group in 1984 was to better characterize the infiltration characteristics of Grand Valley soils in order to improve design and management of graded furrows. The recirculating infiltrometer was developed, tested, and found to function well. It will be used to study effects of controlled conditions, such as stream size, wetted perimeter, water quality, tillage practices, etc., on infiltration.

The zero-inertia model for furrow flow simulation was made operational on a Wang 2200 computer system. Model simulations will be used to check the validity of infiltration predictions to improve furrow irrigation efficiency. Advance and infiltration data were collected on three common soil types for model verification and for use in estimating spatial variability of infiltration.

The hydraulic weighing lysimeters were used in 1984 to develop a method by which remotely sensed data can be used to estimate evapotranspiration (ET) of agricultural crops. Reflected visible and near-infrared canopy radiation from corn was measured daily with a three-band radiometer. Measured values were related to measured ET and climate data to develop real time crop coefficients.

Snake River Conservation Research Center

The Kimberly group developed electronic open channel flow logging equipment which is now being used in both Grand Valley and Unita Basin SCS monitoring programs.

Three cablegation systems in the Grand Valley were monitored throughout the 1984 season. On one system, the farmer raised 185 bushels per acre of corn with 23 inches of infiltrated water, in spite of one-third of the field being

a shallow shale soil. On the other two fields, in spite of the uniform application provided by the cablegation systems, the farmers infiltrated 5 to 10 inches more water than the crops could utilize. On all three fields, 30 to 50% of the applied water ran off as tailwater. All three farmers are pleased with their cablegation systems. They realize that cablegation systems give them ability to irrigate more uniformly. They tend to apply water for less time per irrigation which decreases the probability of deep percolation and reduces the river's salt load. However, because irrigation now takes less labor, they are tempted to irrigate more frequently which can increase deep percolation. Now that they have the physical ability to apply their water optimally at little extra cost, they can more effectively use information concerning needs of their crops for water; how the timing and amount of the next increment of water will affect the location of nitrates and other salts relative to their crop's root system; and potentials for increasing crop production by adding their N via their irrigation water.

Wheel compacting and chiseling furrows, surge irrigation, and organic matter incorporation were studied as means of changing furrow infiltration rates. By differentially applying these treatments down furrows, the effects of the non-uniform intake opportunity time can be counteracted allowing more uniform water distribution and less deep percolation. On a 600-ft. long field with Portneuf silt loam soil at Kimberly, the measured seasonal infiltrated depths were 61%, 28%, 22%, and 17% higher in the top third of the fields as compared to the bottom third with no treatment (check), chiseling the bottom third, wheel compacting the top two-thirds, and surging the top two-thirds, respectively. Organic matter incorporation of three tons per acre of straw and five tons per acre of manure increased seasonal infiltration rates 30 to 50%.

Time and moderate water contents of soil, following disruption, were found to be major factors increasing cohesion and maintaining subsequent infiltration rates. Understanding effects of these and other basic factors affecting soil infiltration rates will help develop management practices which will decrease deep percolation, improve water use efficiency, and increase crop production.

E. Monitoring and Evaluation

Grand Valley, Colorado

The Grand Valley monitoring and evaluation (M&E) program made significant progress in fiscal year 1984. The major equipment components to automatically monitor irrigation flows have been purchased and field tested. Twelve irrigation M&E sites were selected during FY 1984. At four sites equipment was installed and has been operational for a portion of the 1984 irrigation season. A complete set of inflow-outflow data was collected for eleven irrigations on the four fields.

Two SNOTEL telemetry weather stations were installed to provide climatological data for calculating evapo-transpiration (ET) rates as an estimate of crop consumptive use. However, access to weather information was inadequate for calculating a precise ET, so the final irrigation balances for eleven irrigation events will be estimates. The electronic components to monitor irrigation flows on the twelve sites will be in place by the end of March 1985 ready to collect irrigation data for the entire 1985 irrigation season.

The software to handle the M&E data processing and evaluation, not commercially available, is being developed locally with programming assistance from the Fort Collins Computer Center. The data handling sophistication built into the program will improve as more experience is gained with data acquisition and evaluation. Programming is progressing well, but we anticipate the need for a great deal more programming time in fiscal year 1985.

More work is scheduled to develop and implement an economic monitoring and evaluation program. An economic evaluation worksheet similar to the one used by SCS staff may be a way to provide the baseline information on selected sites. A follow-up system needs to be developed to track the economic impacts of the onfarm irrigation improvements. To fully implement an M&E effort with economic evaluation and irrigation water management follow-up, additional personnel will be required.

Fiscal year 1984 has been a valuable learning experience for the M&E staff. The new technology that allows collecting the types of information needed to monitor irrigation flows, brought its own unique set of challenges as equipment was being installed and tested. The 1985 irrigation season provides the opportunity for collecting data needed to provide significant new insights into understanding irrigation improvements and design needed to provide new levels of reliability for making irrigation improvements for salinity control.

Uinta Basin, Utah

Salt load monitoring will be done on 39 sites representing dominant soils, geology, crops and irrigation systems. Data from sites with unimproved irrigation systems and from sites before improvement of the irrigation system will be the reference baseline from which salt load reduction is estimated.

Wildlife habitat quality and quantity is monitored on cover types for six key wildlife species using habitat evaluation procedures (HEP) developed by the U.S. Fish and Wildlife Service. Habitat unit values calculated from HEP data evaluate wildlife habitat quality. Vegetation trend transects and cover type mapping by electronic analysis of remotely sensed images is used to monitor habitat quantity. Data will be collected once every three years on ninety wildlife habitat sites. Ground water will be monitored on wetlands to be correlated with vegetation, wildlife habitat quality and irrigation systems.

Comparison of net farm income of farm operators with and without participation in CRSC program will be calculated by case file economic analysis. Sample size is 150 total case studies (fifty case studies per year with follow-up information every three years).

Evaluation of data collected will provide feedback on improved irrigation systems implemented under CRSC program. This will help to answer questions on what structural improvements and management techniques are best suited to reduction of salt loading and what are the economic benefits vs. implementation costs of irrigation system improvement alternatives.

Monitoring activities that occurred in 1984 include: electronic data logging equipment purchased and installed on six irrigated fields, six automated climate stations and SNOTEL radio systems for monitoring evapo-transpiration, selection and preparation of fifteen irrigated fields for monitoring and data selection from thirty wildlife habitat sites for evaluation.

VII. PROJECTED 1985 ACTIVITIES

With passage of PL.98-569, the USDA CRSC program will take on a much broader and more extensive range of activities for 1985. While program and project funding still remains a major obstacle because of the federal budget deficits, there are many other priority activities needing attention.

It will be important to continue to maintain a meaningful and realistic ongoing salinity control program in both Grand Valley and the Unita Basin. This may become increasingly difficult with the current status of the agricultural economy. Cost-shares, staffing, and monitoring efforts will be maintained to the degree financial resources permit.

The new authority for the USDA voluntary onfarm program also requires that a Secretarial Delegations of Authority for program responsibilities be completed. Likewise, program rules and regulations must be formulated, approved, and published in the Federal Register before the new program can be formally initiated.

Another major activity includes closer coordination between the Bureau of Reclamation and the USDA agencies. Of special importance and priority is the need for BR and SCS to provide improved technical coordination. Items such as: salt load and salt load reduction numbers; cost effectiveness criteria and analysis; economic analysis of program costs and benefits; improved coordination of planning and implementation schedules; and monitoring and evaluation activities all need additional attention. The BR/SCS Technical Policy Coordination Committee will be the principle vehicle for addressing these program needs and technical differences.

The USDA Salinity Control Coordinating Committee will also focus additional attention on improved communications and closer working relationships with the Colorado River Basin states interests. The basin states now have a keener interest in overall USDA CRSC program operations, procedures, and expenditures because of the power revenue Basin Fund reimbursement provisions of PL.98-569. In 1985, USDA expects to improve the agencies dialogue with the CRBSC Advisory Council, the CRBSC Forum, and the Forum Work Group.

